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imagination and the ability to act a part gravely, may be made the basis of a pleasant evening's entertainment. The writer has seen it used on more than one occasion, but most successfully as the main feature of a Halloween party with a member of the faculty taking the part of the fortune-teller. The house was decorated with jack-o'-lanterns, paper witches, black cats, etc., and an appropriate booth in a corner of a room was provided for the fortune-teller. The "fortunes" told were based on the "Ancient Science of Numbers" but obviously supplemented with much other real and imaginary information more or less surreptitiously obtained by the amateur revealer of mysteries.

An evening at chess. Chess is essentially a mathematical game, as is evidenced by the fact that the Royal Society Index lists no less than thirty mathematical papers on the "Knight's Move" alone. Mathematical students generally are fond of the game or enjoy learning it when not already players.

For an evening at chess the first requisite is a sufficient number of boards and sets of men so that every member can play. Before the play is begun a member of the club presents a brief sketch of the history of the game and the mathematical problems connected with it. The club is then divided into players and beginners. If convenient, the players may go into one room and the beginners into another. The players are seated at small tables and the play proceeds as in a progressive card game except that the time for play is limited (say to 10 or 15 minutes) and one of the best players, who has been chosen to act as judge and timekeeper, awards all unfinished games to the player who, in his judgment, holds the more advantageous position.

The beginners include all who have not yet learned the game. Two or three experienced players explain the game to them, illustrating by means of simple games based on easy checkmates such as the "fool's mate" and the "scholar's mate." After sufficient instruction has been given, the beginners divide into pairs and spend the evening playing, their instructors remaining in attendance to answer questions or give other assistance.

PROBLEMS AND SOLUTIONS.

EDITED BY B. F. FINKEL AND OTTO DUNKEL.

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PROBLEMS FOR SOLUTION.

2780. Proposed by ELMER LATSHAW, West Philadelphia, Pa.

A polygon whose sides are a, $2a$, $3a$, $4a$ is inscribed in a circle. Find the radius of the circle.

2781. Proposed by J. L. RILEY, Stephensville, Texas.

Show that the asymptotic lines on a pseudospherical surface are curves of constant torsion.

2782. Proposed by WARREN WEAVER, University of Wisconsin.

A great number N of jackstraws are jumbled up in such a way that any one is as likely to have one direction as another. Show that the probable number that make an angle lying between θ_1 and θ_2 as measured from any given direction is equal to $\frac{N(\cos\theta_1 - \cos\theta_2)}{2}$.

2783. Proposed by C. C. BRAMBLE, U. S. Naval Academy.

Two players A and B take turns throwing a single die, A leading. The one first making a score of 3 aces is to be the winner. Find the probability that A will win.

416 (Algebra) [May, 1914]. Proposed by C. E. FLANAGAN, Wheeling, Va.

The sides of a given rectangle are a and b in which a rectangle is to be inscribed one of whose sides is c. Find the other side, using Euler's rule for quartics.

353 (Calculus) [February, 1914]. Proposed by R. P. LOCHNER, Philadelphia, Pa.

The center of a sphere, radius $R = 5$ inches, is $a = 10$ inches above the surface of a sphere, radius $12\frac{1}{2}$ inches. There is a point of light at $b = 1$ inch horizontally from a point $c = 10$ inches vertically above the surface of the first sphere. What is the area of the shadow which the upper sphere casts on the lower one?

287 (Mechanics) [February, 1914]. Proposed by W. H. DRANE, Lebanon, Tenn.

While sitting in an empaled enclosure, I noticed that the spokes of the wheels of passing automobiles, when viewed through the pickets of the fence, appeared to revolve more slowly than they really did, and in some instances even appeared to be revolving in a direction opposite to that in which they were really turning. Explain this optical illusion.

202 (Number Theory) [December, 1913]. Proposed by A. R. SCHWEITZER, Chicago, Ill.

There exists an infinitude of systems of dyads $\{\alpha\beta\}$ in 7, 9, 11, etc., elements such that each system has the following properties: (1) if $\alpha\beta$ is in the set, then $\beta\alpha$ is not in the set; (2) for each dyad $\alpha\beta$ in the set there exists an element ξ such that $\xi\beta$ and $\alpha\xi$ are also in the set. For example, such a system is,

$$\begin{array}{ccccccccc}
12, & 23, & 34, & 45, & 56, & 67, & 78, & 89, & 91 \\
13, & 24, & 35, & 46, & 57, & 68, & 79, & 81, & 92 \\
14, & 25, & 36, & 47, & 58, & 69, & 71, & 82, & 93 \\
51, & 62, & 73, & 84, & 95, & 16, & 27, & 38, & 49.
\end{array}$$

Investigate the existence of

I. A finite set of triads $\{\alpha\beta\gamma\}$ such that (1) if $\alpha\beta\gamma$ is in the set, then $\beta\gamma\alpha$, $\gamma\alpha\beta$ are also in the set but $\beta\alpha\gamma$ is not in the set; (2) for each triad $\alpha\beta\gamma$ in the set there exists an element ξ such that $\xi\beta\gamma$, $\alpha\xi\gamma$, $\alpha\beta\xi$ are also in the set.

II. A finite set of tetrads $\{\alpha\beta\gamma\delta\}$ such that (1) if $\alpha\beta\gamma\delta$ is in the set, then $\beta\gamma\alpha\delta$, $\gamma\alpha\beta\delta$, $\gamma\delta\alpha\beta$ are also in the set but $\beta\alpha\gamma\delta$ is not in the set; (2) for each tetrad $\alpha\beta\gamma\delta$ in the set there exists an element ξ such that $\xi\beta\gamma\delta$, $\alpha\xi\gamma\delta$, $\alpha\beta\xi\delta$, $\alpha\beta\gamma\xi$ are also in the set.

The problem for alternating n-ads for $n > 4$ is obvious.

SOLUTIONS OF PROBLEMS.

2699, 2710 [May, June, 1918; April, 1919]. Proposed by the late R. E. MOORE, University of Wisconsin.

If $a_k^{(r)}$ denotes the kth term of an arithmetic progression of order r, and c_k denotes the kth binomial coefficient in the expansion of $(a - b)^n$ (n being a positive integer), show that

$$s \equiv \sum_{k=1}^{n+1} c_k a_k^{(r)} = 0, \text{ if } n > r.$$

II. SOLUTION BY A. PELLETIER, Montreal, Canada.

The terms of the arithmetic progression may be expressed in the usual form as follows:

$$a, \qquad a + \Delta_1, \qquad a + 2\Delta_1 + \Delta_2, \qquad a + 3\Delta_1 + 3\Delta_2 + \Delta_3, \qquad \cdots.$$

We have to prove that

$$\begin{aligned}
&c_0 a + c_1(a + \Delta_1) + c_2(a + 2\Delta_1 + \Delta_2) + c_3(a + 3\Delta_1 + 3\Delta_2 + \Delta_3) \\
&\qquad\qquad + \cdots + c_n\left(a + n\Delta_1 + \frac{n(n-1)}{1\cdot 2}\Delta_2 + \cdots\right) = 0,
\end{aligned}$$